CWRS Varietal Response to Manipulator

2019 Project Report

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Objectives and Rationale:

Project Objectives: To demonstrate the response of various Canadian Western Red Spring (CWRS) wheat varieties to the application of Manipulator.

Project Rationale: In 2018, Manipulator (a plant growth regulator [PGR]) was cleared of MRL issues for export to the United States. This opened up an opportunity for producers in Saskatchewan to use this PGR product more freely, and has subsequently generated a lot of questions surrounding its agronomic use. Previously NARF and IHARF had completed agronomic work with Manipulator to determine the interaction between fertility rate and PGR application timing, on a single variety. This work in 2015 found that under high fertility, PGR application reduced lodging, increased yields, and promoted slight protein increases. However, it is well known that each variety of CWRS behaves differently for lodging, yield, and protein based on its genetic characteristics. This leaves producers to question if various CWRS varieties will respond differently to PGR application. Some industry professionals suggest that shorter varieties and/or varieties with good lodging resistance are unresponsive to PGR application. Others suggest that PGR application may even damage some varieties. Currently there has been little to no valid comparison work as to how different CWRS varieties respond to Manipulator application. Thus, the intended benefit of this demonstration was to identify the height, lodging, yield, and protein response of CWRS varieties to Manipulator application, under increased fertility conditions.

Methodology and Results:

Methodology: This small plot demonstration was located at SE 31-44-18-W2 in the RM of Star City, near Melfort, SK. The demonstration was set up in a Randomized Complete Block Design with 4 replicates. Treatments varied based on 5 different CWRS variety selections and 2 different application timings. Each variety was also subjected to no PGR application for comparison. These factors were combined to generate 15 treatments (Table 1).

Table 1: Treatments used in CWRS varietal response to Manipulator in Melfort, SK 2019.

TRT #	Variety	Application Timing
1	Carberry (14.6%/VG/82cm)	1 to 2 nodes (0.7 L/ac)
2	AAC Cameron VB (-0.7%/F/+17cm)	
3	CDC Titanium VB (+0.6%/P/+10cm)	
4	CDC Utmost VB (-0.4%/F/+12cm)	
5	AAC Brandon (-0.4%/G/0cm)	
6	Carberry	2 leaves (0.3 L/ac) + 1-2 nodes (0.4 L/ac)
7	AAC Cameron VB	
8	CDC Titanium VB	
9	CDC Utmost VB	
10	AAC Brandon	
11	Carberry	Untreated
12	AAC Cameron VB	
13	CDC Titanium VB	
14	CDC Utmost VB	
15	AAC Brandon	

At Melfort plots were 2m wide by 7m long. Prior to seeding the test site was soil sampled for residual nutrient levels (Table 2). Results of the soil test were used for fertilizer recommendations. On May 14th, 2019 all plots were seeded at a 1.5-inch depth into canola stubble. Seeding was done using a 6-row Fabro plot seeder on 12-inch row spacing. The seeding rate for all five varieties were adjusted for their individual germination percentages and TKWs, while targeting a seeding rate of 400 seeds/m^2. Germination and TKW for each variety were as follows: Carberry (99%, 36.8g); AAC Cameron VB (98%, 47.2g); CDC Titanium VB (97%, 37.6g); CDC Utmost VB (98%, 38.8g); AAC Brandon (99%, 41g). All fertilizer was applied based on a 60 bu/ac yield goal, with N applied at 150% of the recommended rate. A total of 201 lb N/ac of Nitrogen was applied as 46-0-0 between the side and midrow bands. Phosphorus was applied as MAP (11-52-0) and was seed-placed at 21 lbs P/ac. Potassium was applied as 0-0-60-0 and was side-band at 10 lbs K/ac. No additional sulphur was required.

Table 2: Residual soil nutrient levels (0-12") found in CWRS varietal response to Manipulator, in Melfort 2019.

Residual Soil Levels			
Nitrogen (lb/ac)	*Phosphorus (ppm)*	*Potassium (ppm)*	*Sulphur (lb/ac)*
19	15	500	68

This trial received crop protection products as required. All 5 varieties received Vibrance Quattro as a seed treatment at 325mL/ 100kg of seed. An in-crop herbicide application was done of Axial at 0.5L/ac on June 27th and Prestige XC (0.13L/ac of A and 0.6L/ac of B) on July 4th. No pre-emergent herbicides, fungicides, insecticides, or desiccants were applied. Manipulator was applied on June 12th at 0.3 L/ac when the plants were at the 2-leaf stage for the split application treatments. On July 3rd, the average growth stage was 1 to 2 nodes and Manipulator was applied at 0.7 L/ac to the one application treatments, and at 0.4 L/ac to the split application treatments. Lastly, all plots were harvested on October 6th with 5 full crop rows collected.

To assess treatment differences, data collection consisted of height, lodging, yield and % protein. An economic analysis was also completed. Methodology for this data collection is described below. The single site-year of data was analyzed using a Factorial ANOVA in Statistix 10.

Results:

Environmental Conditions: May through August were cooler than normal, while September was warmer (Table 3). Both May and August were 1.9°C cooler, while June, July, and September were within 0.4 to 0.6°C of the long-term climate normal for each respective month. May, July, and August received less precipitation than normal, while June and September had more than normal (Table 3). However, both July and September were within 4 mm of the long-term climate normal, while May, June, and August were within 21 to 33 mm of their normal. Due to the cool, dry conditions in May, seed germination was slow and sporadic. The wet conditions in June, assisted in plant establishment, but also resulted in more seedling germination. This caused for multiple growth stages within a small area, ultimately leading to increased variability within and between plots. This inevitably led to delays in maturity and harvesting. Overall, the growing season was slightly cooler and drier than the long-term climate normal.

Table 3: Mean temperatures and precipitation collect from the Environment Canada Weather Station at Melfort SK., from May to September 2019.

	May	June	July	August	September	Average/Total
			--- Mean Temperature (°C) ---			
2019	8.8	15.3	16.9	14.9	11.2	13.4
Long-Term[x]	10.7	15.9	17.5	16.8	10.8	14.3
			--- Total Precipitation (mm) ---			
2019	18.8	87.4	72.7	30.7	43.0	252.6
Long-Term[x]	42.9	54.3	76.7	52.4	38.7	265.0

[x] Long-term climate normal from Environment Canada Weather Station located at Melfort SK., from 1981-2010

Height: Height was determined by measuring the average of 5 plants in 3 areas (front, middle and back) per plot. Overall, height was significantly different between the varieties and the application timings, but was not significantly different between the interaction of variety and timing (Table 4). In the demonstration, AAC Cameron VB was the tallest, followed by CDC Titanium VB and CDC Utmost VB, with Carberry and AAC Brandon being the shortest (Table 5). The high rankings were as expected and followed the Varieties of Grain Crops 2019 rating (Carberry 82 cm; AAC Brandon +0cm; CDC Titanium VB +10cm; CDC Utmost VB +12cm; AAC Cameron +17cm). On average, PGR application resulted in a modest 3 to 5 cm reduction in height (Table 5). The average height reduction is less than in previous findings; however, due to the dry and cold growing season, these results were not unexpected. The non-significant interaction between variety and application timing, suggests that each variety responded to Manipulator application equally within and between application timings.

Table 4: Statistical summary for CWRS varietal response to Manipulator in Melfort, SK 2019.

	Height (cm)[z]	Lodging[z]	Yield (bu/ac)[z]	Protein (%)[z]
Variety (V)	<0.0001***	NS	<0.0001***	<0.0001***
Timing (T)	0.0007**	NS	0.1290	0.0124*
V*T	0.2244	NS	0.1890	0.7122
Grand Mean	82.3	0	76.2	14.1
CV	4.28	NS	3.8	3.3

[z] *** p<0.0001; ** p<0.01; * p<0.05; NS – Not significant

Table 5: Treatment means for CWRS varietal response to manipulator in Melfort, SK 2019.

		Height (cm)	Yield (bu/ac)	Protein (%)
Variety				
Carberry		75.6 c	76.9 b	14.0 b
AAC Cameron VB		91.0 a	86.1 a	13.6 c
CDC Titanium VB		85.2 b	68.8 c	14.9 a
CDC Utmost VB		83.5 b	70.5 c	14.2 b
AAC Brandon		76.2 c	78.5 b	13.8 bc
Timing				
Untreated		84.8 a	75.0 a	14.3 a
Single Application		80.0 b	76.5 a	13.9 b
Split Application		82.1 b	77.0 a	14.1 ab
*V * T*				
Untreated	Carberry	76.6 efgh	75.6 cd	14.3 bcd
	AAC Cameron VB	95.8 a	83.5 b	13.9 cdef
	CDC Titanium VB	85.8 bc	69.1 ef	15.5 a
	CDC Utmost VB	85.7 bc	68.5 f	14.2 bcd
	AAC Brandon	80.1 def	78.5 c	13.9 cdef
Single Application	Carberry	75.3 fgh	77.0 cd	13.7 def
	AAC Cameron VB	86.4 bc	85.2 b	13.3 f
	CDC Titanium VB	83.8 cd	68.0 f	14.5 bcd
	CDC Utmost VB	82.9 cd	73.1 de	14.0 cdef
	AAC Brandon	71.5 h	79.1 c	13.8 def
Split Application	Carberry	74.9 gh	78.3 c	14.1 cdef
	AAC Cameron VB	90.8 ab	89.6 a	13.5 ef
	CDC Titanium VB	85.9 bc	69.2 ef	14.9 ab
	CDC Utmost VB	81.8 cde	70.0 ef	14.2 bcd
	AAC Brandon	76.9 efg	77.8 c	13.7 def

Lodging: Lodging was accounted for prior to harvest using the Belgian lodging scale. Despite the increased fertility levels applied to the trial, lodging did not occur in 2019. This is likely due to a mixture of factors attributed to the dry growing season.

Yield: Yield was obtained by cleaning and weighing each harvested plot. Clean weights were converted into bu/ac equivalents and further corrected for 14.5% moisture. Variety was the only factor to have a significant effect on wheat yield in this demonstration (Table 4). Overall, AAC Cameron VB was the highest yielding variety, while CDC Titanium VB and CDC Utmost VB were the lowest (Table 5). This result is interesting because Carberry is generally lower yielding than the other four varieties. However, its likely a reflection of each variety's environmental response to the growing season. As with height, results suggest that each variety responds similarly to PGR application, within and between application timings.

Protein: Protein was determined by obtaining a 500g subsample from each clean harvested sample and sending away for analysis. Protein was found to be significant when comparing variety and timing; While

the interaction was once again insignificant (Table 4). Overall, CDC Titanium VB demonstrated the highest overall protein at 14.9%, while AAC Cameron VB demonstrated the lowest average protein at 13.6%. It was unexpected that protein was affected by PGR application, as yield was unaffected by PGR application timing. Yield and protein have an inverse relationship in which when yield goes up, protein goes down and vice versa. However, in this demonstration when a single application at the 1 to 2 nodes stage was completed, protein dropped by 0.4% compared to when no PGR was used (Table 5). However, when the PGR application was split, protein levels were only 0.2% less than the untreated controls. Although the response of protein levels to PGR application are significant in this demonstration, the agronomic implications of this effect are relatively minor.

Economic Analysis: For this economic analysis, information was taken from the 2020 Crop Planning Guide Published by the Saskatchewan Ministry of Agriculture for the Black soil zone. To estimate income, the yield of each treatment was multiplied by a price of $6.42/bu. To estimate expenses, each treatment had an estimated $208/ac cost associated for seed, fertilizer, and crop protection products. For the single application treatments, an additional $29/ac was added to account for the $10/ac PGR and $19/ac sprayer fuel costs. For the split application treatments, the sprayer fuel costs were doubled for total of $49/ac Thus, the untreated treatments had a gross expense cost of $208/ac, single application $236/ac, and the split application $256/ac. The net income for each treatment is found in Table 6. Due to the increased cost associated with split application, the net income of each treatment was less than the single application and untreated treatments. There was one exception where AAC Brandon had a greater net income with split application than single application, but less than the untreated. Overall, net income declined with PGR application in 2019. This is largely due to the minimal yield increases associated with PGR application, the additional sprayer pass(es), and response to the environment. However, this rough economic analysis is a rough outline of what a producer might experience in any given year. Thus, producers need to tailor their gross expense costs to their operation, to have a more informed decision on the potential benefits of PGR application on their farm.

Table 6: Net Income per Treatment for CWRS varietal response to manipulator in Melfort, SK 2019.

Application Timing	Variety	NET Income ($/ac)
Untreated	Carberry	284
	AAC Cameron VB	407
	CDC Titanium VB	343
	CDC Utmost VB	343
	AAC Brandon	307
Single Application	Carberry	247
	AAC Cameron VB	318
	CDC Titanium VB	301
	CDC Utmost VB	295
	AAC Brandon	222
Split Application	Carberry	225
	AAC Cameron VB	327
	CDC Titanium VB	295
	CDC Utmost VB	269
	AAC Brandon	238

Conclusions and Recommendations: Due to the dry and cool growing season in 2019, the response to PGR application was overall minimal. Height, yield, and protein differences were largely influenced by genetic differences between varieties and their response to the environment. In 2019, PGR application reduced height, did not affect yield, and slightly decreased protein. The single application of PGR resulted in greater height reductions, while the split application did not reduce protein levels as greatly. Despite the statistically significant response of height and protein to PGR application, the differences were small and of relatively little agronomic importance. When net income was considered, PGR application resulted in decreased profit, and more so when a split application was used due to the additional sprayer passes. Lastly, there was no significant interaction between variety and timing for height, yield, and protein. This demonstrates that each variety responds similarly to PGR application, regardless of the growth stage and method used to apply the PGR. Therefore, when the growing season is dry and cool, CWRS varieties do not respond to PGR application as greatly as in warm, wet years. Thus, under growing conditions similar to the 2019 growing season, varietal response to PGR application are minimal, yet similar across varieties.

Supporting Information:

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Abstract

Abstract/Summary: Currently there is little to no valid comparison work as to how different CWRS varieties respond to Manipulator (PGR) application. Thus, this demonstration was conducted to identify the height, lodging, yield, and protein response of five CWRS varieties to Manipulator application under increased fertility conditions. This small plot demonstration was located at SE 31-44-18-W2 in the RM of Star City, near Melfort, SK. The demonstration was set up in a Randomized Complete Block Design with 4 replicates. Five CWRS varieties were either grown without PGR application, or treated with Manipulator as a single (2 nodes) or split (2 leave + 2 nodes) timing application. Due to the dry, cool growing season in 2019, CWRS response to PGR application was minimal. Height, yield, and protein differences were largely influenced by the genetic variations between the varieties. In 2019, PGR application reduced height, did not affect yield, and slightly decreased protein. The single application of PGR resulted in greater height reductions, while the split application did not reduce protein levels as greatly. Despite the statistically significant response of height and protein to PGR application, the differences were small and of relatively little agronomic importance. Lastly, there were no significant interactions between variety and timing for height, yield, and protein. This result suggests that each CWRS variety responds similarly to PGR application, regardless of the growth stage and method used to apply the PGR. Therefore, when the growing season is dry and cool, CWRS varieties do not respond to PGR application as greatly as in warm, wet years. Furthermore, under these circumstances varietal responses to PGR application are similar across varieties.